

IN THE CLAIMS:

Please amend claims 1, 8, 9 and 11 as follows:

1. (Currently Amended) A magnetic recording medium, the magnetic recording medium having a magnetic film on a non-magnetic substrate by intercalating at least an under layer, the proportion of functional groups having N atoms per 100 carbon atoms in a diamond-like carbon protective mainly composed of carbon for protecting the magnetic film exceeds 20%,
wherein a lubricating film of perfluoroether having at least one functional group is provided on the protective coating.

2. (Currently Amended) The magnetic recording medium according to claim 1,
wherein a lubricating film of perfluoroether having at least one functional group is provided on the protective coating in said diamond-like carbon at least one of the -COOH, -C=O, -COH, and -CNH₂ is included as the functional group.

3. (Withdrawn) A manufacturing method for a magnetic recording medium, in a manufacturing method for a magnetic recording medium having a magnetic film on a non-magnetic substrate by intercalating at least an under layer, characterized in that when a protective film mainly composed of carbon for protecting the magnetic film is formed by an ion beam method or a chemical vapor deposition method, at least one gas among CO₂, NO₂, N₂O is added.

4. (Withdrawn) The manufacturing method for a magnetic recording medium according to claim 3, wherein the protective coating is diamond-like carbon.

5. (Withdrawn) The manufacturing method for a magnetic recording medium according to claim 3, wherein when the protective coating is formed by the ion beam method or the chemical vapor deposition method, at least one of N₂, Ne, Ar, Kr, Xe and hydrocarbon gas or hydrocarbon gas is used.

6. (Withdrawn) A manufacturing method for a magnetic recording medium, in a manufacturing method for a magnetic recording medium having a magnetic film on a non-magnetic substrate by intercalating at least an under layer, characterized in that when a diamond-like carbon protective coating mainly composed of carbon for protecting the magnetic film is formed by an ion beam method or a chemical vapor deposition method, at least one gas among CO_2 , NO_2 , N_2O is added.

7. (Withdrawn) A manufacturing method for a magnetic recording medium, in a manufacturing method for a magnetic recording medium having a magnetic film, a protective coating mainly composed of carbon for protecting the magnetic film and a lubricating film of perfluoroether having at least one functional group on a non-magnetic substrate, characterized in that when the protective coating is formed by an ion beam method or a chemical vapor deposition method using at least one of N_2 , Ne, Ar, Kr, Xe and hydrocarbon gas or hydrocarbon gas, at least one gas among CO_2 , NO_2 , and N_2O is added.

8. (Previously Presented) A magnetic storage apparatus, comprising a magnetic recording medium that in the magnetic recording medium having a magnetic film on a non-magnetic substrate by intercalating at least an under layer, a proportion of functional groups having N atoms per 100 carbon atoms in a diamond-like carbon protective coating mainly composed of carbon for protecting the magnetic film exceeds 20%, and a lubricating film of perfluoroether having at least one functional group provided on the protective coating,
a driving part for driving the magnetic recording medium,
a magnetic head having a recording part and a reproducing part,
a recovery reproducing signal processing part for giving and receiving a signal to and from the magnetic head, and a magnetoresistive head as the reproducing part of the magnetic head.

9. (Canceled).

10. (Canceled).

11. (Previously Presented) A magnetic storage apparatus, comprising a magnetic recording medium having a magnetic film on a non-magnetic substrate by intercalating at least an under layer, a proportion of functional groups having N atoms per 100 carbon atoms in a diamond-like carbon protective coating mainly composed of carbon for protecting the magnetic film exceeds 20%, and a lubricating film of perfluoroether having at least one functional group provided on the protective coating.

a driving part for driving the magnetic recording medium, a magnetic head having a recording part and a reproducing part,

a recording reproducing signal processing part magnetic head, and a magnetoresistive head as the reproducing part of the magnetic head.

12. (New) The magnetic recording medium according to claim 1, wherein the functional group in said diamond-like carbon is identified by a tag modification method using molecules which have functional groups interacting with the protective coating surface functional groups quantitatively and irreversibly by molecular recognition, and contain fluorine atoms which have high sensitivity coefficient to ESCA.

13. (New) A magnetic recording medium, the magnetic recording medium having a magnetic film on a non-magnetic substrate by intercalating at least a seed layer and an underlayer mainly composed of Cr, the proportion of functional group having N atoms per 100 carbon atoms in a diamond-like carbon protective mainly composed of carbon for protecting the magnetic film exceeds 20%, and a lubricating film of perfluoroether having at least one of the functional group.

14. (New) A magnetic recording medium, the magnetic recording medium having a magnetic film on a non-magnetic substrate by intercalating at least a seed layer and an underlayer mainly composed of Cr, the proportion of functional group composed of at least one of the

-COOH, -C=O, -COH, and -NH₂ per 100 carbon atoms in a diamond-like carbon protective mainly composed of carbon for protecting the magnetic film exceeds 20%, and a lubricating film of perfluorether having at least one of the functional group.

15. (New) A magnetic recording medium according to claim 13, wherein said proportion of functional group is identified by tag modification method using molecules which have functional groups interacting with the protective coating surface functional groups quantitatively and irreversibly by molecular recognition, and contain fluorine atoms which have high sensitivity coefficient to ESCA.

16. (New) A magnetic recording medium according to claim 14, wherein said proportion of functional group is identified by tag method using molecules which have functional groups interacting with the protective coating surface functional groups quantitatively and irreversibly by molecular recognition, and contain fluorine atoms which have high sensitivity coefficient to ESCA.